

MHT CET 30 April Shift 1 Question Paper with Solutions

Total Time Allowed : 3 hours	Maximum Marks : 200	Total Questions : 17	Questions to be answered :17
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General Instructions

Read the following instructions very carefully and strictly follow them:

- (1) This question booklet contains 150 Multiple Choice Questions (MCQs).
Section-A: Physics Chemistry - 50 Questions each and
Section-B: Mathematics - 50 Questions.
- (2) Choice and sequence for attempting questions will be as per the convenience of the candidate.
- (3) Read each question carefully.
- (4) Determine the one correct answer out of the four available options given for each question. (5) Each question with correct response shall be awarded one (1) mark. There shall be no negative marking.
- (6) No mark shall be granted for marking two or more answers of same question, scratching or overwriting.
- (7) Duration of paper is 3 Hours.

BIOLOGY

1. Roan Cattle is an example of —

- (1) Incomplete Dominance
- (2) Codominance
- (3) Complete Dominance
- (4) Polygenic Inheritance

Correct Answer: (2) Codominance

Solution: Roan cattle exhibit a coat color where both red and white hairs are present and visibly expressed simultaneously. This pattern is a classic example of codominance, where both alleles in a heterozygous organism are fully expressed without blending.

In codominance, neither allele is recessive or dominant over the other. Instead, both alleles contribute to the phenotype, resulting in a distinct appearance that shows both traits equally. In the case of roan cattle, the presence of both red and white coat colors is due to the expression of both alleles simultaneously.

💡 Quick Tip

Codominance occurs when both alleles in a gene pair are fully expressed, resulting in offspring with a phenotype that is neither dominant nor recessive.

2. Ti plasmid is obtained from —

- (1) Escherichia coli
- (2) Agrobacterium tumefaciens
- (3) Bacillus subtilis
- (4) Saccharomyces cerevisiae

Correct Answer: (2) Agrobacterium tumefaciens

Solution: The Ti (tumor-inducing) plasmid is a large plasmid found in the bacterium Agrobacterium tumefaciens. This plasmid is responsible for transferring a segment of its DNA into plant cells, causing the formation of crown gall tumors. The Ti plasmid is widely utilized in plant genetic engineering to introduce new genes into plants.

Researchers exploit the Ti plasmid's natural ability to transfer DNA to manipulate plant genomes. By replacing the tumor-inducing genes with desired genes, scientists can create genetically modified plants with beneficial traits, such as pest resistance or increased yield.

💡 Quick Tip

Agrobacterium tumefaciens utilizes the Ti plasmid to transfer genetic material to plants, a mechanism that has been harnessed for creating genetically modified plants.

3. Which of the following best describes the widely accepted root pressure theory in plants?

- (1) It explains the mechanism of water movement through transpiration pull.
- (2) It describes the active uptake of minerals from the soil.
- (3) It refers to the pressure exerted by roots to push water upwards through the xylem.
- (4) It relates to the diffusion of gases in plant cells.

Correct Answer: (3) It refers to the pressure exerted by roots to push water upwards through the xylem.

Solution: The root pressure theory explains how plants can transport water from the roots to the shoots without relying solely on transpiration pull. Root pressure is gener-

ated when ions are actively transported into the root xylem, lowering the water potential and causing water to enter the xylem from the soil by osmosis. This influx of water creates a positive pressure that pushes water upwards through the xylem vessels.

Mechanism of Root Pressure:

Transport of Ions → Lowered Water Potential → Water Uptake by Osmosis → Positive Pressure

Conclusion: Root pressure is a vital mechanism that assists in the upward movement of water, especially during times when transpiration is low, such as at night.

💡 Quick Tip

Root pressure is particularly important in small plants and during the early stages of plant growth, helping to maintain water flow in the absence of strong transpiration forces.

4. Which of the following statements about the prostate gland is correct?

- (1) It is responsible for producing insulin.
- (2) It secretes a fluid that nourishes and transports sperm.
- (3) It regulates the levels of calcium in the blood.
- (4) It is involved in the filtration of blood to produce urine.

Correct Answer: (2) It secretes a fluid that nourishes and transports sperm.

Solution: The prostate gland is a vital component of the male reproductive system. It produces a seminal fluid that constitutes a significant portion of semen. This fluid contains enzymes, such as prostate-specific antigen (PSA), which help to liquefy semen after ejaculation, aiding in the nourishment and transport of sperm.

Functions of the Prostate Gland:

- Secretion of prostate fluid: Provides nutrients for sperm.
- Production of PSA: Helps in semen liquefaction.
- Muscle contractions: Facilitate the expulsion of semen during ejaculation.

Conclusion: The prostate gland plays a crucial role in male fertility by producing fluids that support and transport sperm.

💡 Quick Tip

An enlarged prostate can lead to urinary difficulties, highlighting the importance of prostate health in overall well-being.

5. Which of the following correctly lists the stages of human embryo development in order?

- (1) Morula, Blastocyst, Gastrulation, Neurulation
- (2) Blastocyst, Morula, Neurulation, Gastrulation
- (3) Neurulation, Gastrulation, Morula, Blastocyst
- (4) Gastrulation, Neurulation, Blastocyst, Morula

Correct Answer: (1) Morula, Blastocyst, Gastrulation, Neurulation

Solution: Human embryonic development progresses through several well-defined stages:

- **Morula:** A solid ball of cells resulting from the division of a fertilized egg.
- **Blastocyst:** The morula develops a fluid-filled cavity, differentiating into the inner cell mass and the trophoblast.
- **Gastrulation:** Formation of the three germ layers (ectoderm, mesoderm, endoderm) begins.
- **Neurulation:** Development of the neural tube, which will eventually form the central nervous system.

Sequence of Stages:

Morula → Blastocyst → Gastrulation → Neurulation

Conclusion: The correct order of human embryo development stages is Morula, Blastocyst, Gastrulation, and Neurulation.

💡 Quick Tip

Understanding the stages of embryonic development is fundamental in fields like developmental biology and medicine, as it provides insights into normal and abnormal growth patterns.

6. What is the effect of an increase in substrate concentration on an enzyme-catalyzed reaction?

- (1) The rate of reaction decreases.
- (2) The rate of reaction increases.
- (3) The rate of reaction remains unchanged.
- (4) The enzyme becomes inactive.

Correct Answer: (2) The rate of reaction increases.

Solution: Increasing the substrate concentration in an enzyme-catalyzed reaction generally leads to an increase in the reaction rate. This is because more substrate molecules

are available to bind to the active sites of the enzyme, resulting in the formation of more enzyme-substrate complexes.

However, this increase continues only up to a certain point known as the maximum velocity ($V_{\max}$). Beyond $V_{\max}$, the rate of reaction plateaus as all active sites of the enzyme molecules are occupied, and adding more substrate does not further increase the reaction rate.

Michaelis-Menten Kinetics:

$$\text{Rate} = \frac{V_{\max}[S]}{K_m + [S]}$$

As $[S]$ increases, the rate approaches $V_{\max}$.

Conclusion: An increase in substrate concentration enhances the reaction rate until the enzyme becomes saturated, after which the rate no longer increases.

💡 Quick Tip

Enzyme saturation occurs when all active sites are occupied by substrate molecules, making $V_{\max}$ the upper limit of the reaction rate.

7. Neurohypophysis is differentiated into the following parts except:

- (1) Pars nervosa
- (2) Pars distalis
- (3) Median eminence
- (4) Infundibular stalk

Correct Answer: (2) Pars distalis

Solution: The neurohypophysis, or posterior pituitary, consists of the pars nervosa, median eminence, and infundibular stalk. The pars distalis, however, is a part of the adenohypophysis (anterior pituitary) and is not a component of the neurohypophysis. Therefore, the pars distalis is the part that does not belong to the neurohypophysis.

Components of Neurohypophysis:

- **Pars nervosa:** Stores and releases hormones produced by the hypothalamus.
- **Median eminence:** Connects the neurohypophysis to the hypothalamus.
- **Infundibular stalk:** Acts as a conduit for hormone transportation.

Conclusion: Pars distalis is part of the anterior pituitary and not the neurohypophysis.

💡 Quick Tip

The neurohypophysis primarily functions in the storage and release of hormones like oxytocin and vasopressin, which are produced in the hypothalamus.

8. Which hormone inhibits the growth of plants?

- (1) Auxin
- (2) Cytokinin
- (3) Gibberellin
- (4) Absciscic acid

Correct Answer: (4) Absciscic acid

Solution: Absciscic acid is a plant hormone that plays a crucial role in inhibiting growth. It is involved in various plant developmental processes and stress responses, including seed dormancy, stomatal closure, and inhibition of bud growth. Unlike hormones like auxin and gibberellin, which promote growth, absciscic acid acts as a growth inhibitor, especially under stress conditions such as drought.

Functions of Absciscic Acid:

- Induces seed dormancy to prevent germination during unfavorable conditions.
- Promotes stomatal closure to reduce water loss during drought.
- Inhibits shoot and root growth under stress conditions.

Conclusion: Absciscic acid serves as a key hormone in managing plant growth and responses to environmental stresses by acting as a growth inhibitor.

 Quick Tip

Absciscic acid is essential for plant survival during adverse conditions, helping plants conserve resources and protect against environmental stresses.

9. Which enzyme is responsible for cleaning neurotransmitters in the synaptic cleft?

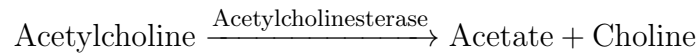
- (1) Acetylcholinesterase
- (2) DNA polymerase
- (3) RNAase
- (4) Lipase

Correct Answer: (1) Acetylcholinesterase

Solution: Acetylcholinesterase is the enzyme responsible for breaking down the neurotransmitter acetylcholine in the synaptic cleft. By hydrolyzing acetylcholine into acetate and choline, acetylcholinesterase terminates the signal transmission between neurons, ensuring that neurotransmitters do not remain in the synaptic cleft longer than necessary. This rapid degradation is essential for the proper functioning of synaptic transmission.

and prevents continuous stimulation of the post-synaptic neuron.

Role of Acetylcholinesterase:



Importance in Neural Function: Efficient clearance of neurotransmitters like acetylcholine is vital for:

- Preventing overstimulation of neurons.
- Ensuring precise control of muscle contractions.
- Maintaining the speed and accuracy of nerve signal transmission.

Conclusion: Acetylcholinesterase plays a critical role in terminating neurotransmitter signals, thereby maintaining the efficiency and regulation of neural communication.

💡 Quick Tip

Inhibition of acetylcholinesterase is a common mechanism of action for certain nerve agents and pesticides, leading to the accumulation of acetylcholine and continuous nerve signal transmission.

10. Which of the following diseases is a result of protein deficiency?

- (1) Scurvy
- (2) Rickets
- (3) Kwashiorkor
- (4) Beriberi

Correct Answer: (3) Kwashiorkor

Solution: Kwashiorkor is a severe form of protein malnutrition characterized by adequate calorie intake but insufficient protein consumption. It commonly affects children in regions experiencing famine or food scarcity. Symptoms include edema, irritability, an enlarged liver, and skin conditions. Unlike marasmus, which results from overall calorie deficiency, kwashiorkor specifically arises from a lack of protein, leading to impaired growth and development.

Characteristics of Kwashiorkor:

- Edema (swelling) due to low plasma protein levels
- Fatty liver (hepatomegaly)
- Dermatitis and hair discoloration
- Irritability and lethargy

Conclusion: Kwashiorkor is directly caused by protein deficiency, distinguishing it from other malnutrition-related diseases that involve deficiencies in vitamins or overall calories.

 Quick Tip

Kwashiorkor is often seen in children transitioning from breastfeeding to a diet high in carbohydrates but low in protein, emphasizing the importance of balanced nutrition during early development.

11. Which hormone is NOT produced by the Islets of Langerhans in the pancreas?

- (1) Insulin
- (2) Glucagon
- (3) Somatostatin
- (4) Adrenaline

Correct Answer: (4) Adrenaline

Solution: The Islets of Langerhans are clusters of endocrine cells in the pancreas responsible for producing several key hormones that regulate blood glucose levels. The primary hormones produced are:

- **Insulin:** Lowers blood glucose levels by facilitating cellular uptake of glucose.
- **Glucagon:** Raises blood glucose levels by stimulating glycogenolysis and gluconeogenesis.
- **Somatostatin:** Inhibits the release of both insulin and glucagon, regulating their secretion.

Adrenaline, also known as epinephrine, is produced by the adrenal glands, not the Islets of Langerhans. It plays a role in the "fight or flight" response, increasing heart rate and blood glucose levels, among other functions.

Conclusion: Adrenaline is not produced by the Islets of Langerhans; it is synthesized in the adrenal medulla.

 Quick Tip

Understanding the specific hormones produced by the Islets of Langerhans is crucial for comprehending pancreatic function and disorders like diabetes mellitus.

12. The enzyme bromelain, found in pineapples, is primarily used for:

- (1) Protein synthesis
- (2) Protein digestion
- (3) Carbohydrate metabolism
- (4) Lipid digestion

Correct Answer: (2) Protein digestion

Solution: Bromelain is a mixture of proteolytic enzymes extracted from pineapples, particularly from the stem and fruit. These enzymes facilitate the breakdown of proteins into amino acids and peptides, aiding in protein digestion. Due to its proteolytic activity, bromelain is utilized in various applications, including meat tenderizing, dietary supplements, and as an anti-inflammatory agent in medical treatments.

Functions of Bromelain:

- Breaks down proteins during digestion
- Acts as a meat tenderizer by degrading tough muscle fibers
- Exhibits anti-inflammatory properties, reducing swelling and pain

Conclusion: Bromelain's primary role is in protein digestion, making it a valuable enzyme both in culinary and medical fields.

💡 Quick Tip

Bromelain is not only beneficial for digestion but also has therapeutic uses, such as reducing inflammation and aiding in wound healing.

13. Which of the following processes is NOT part of cellular respiration?

- (1) Glycolysis
- (2) Krebs Cycle
- (3) Calvin Cycle
- (4) Electron Transport Chain

Correct Answer: (3) Calvin Cycle

Solution: Cellular respiration encompasses the metabolic pathways that cells use to convert biochemical energy from nutrients into adenosine triphosphate (ATP), and then release waste products. The main stages include:

- **Glycolysis:** The breakdown of glucose into pyruvate, producing a small amount of ATP and NADH.
- **Krebs Cycle (Citric Acid Cycle):** Processes pyruvate into carbon dioxide, generating ATP, NADH, and FADH₂.

- **Electron Transport Chain:** Utilizes electrons from NADH and FADH_2 to create a proton gradient that drives ATP synthesis.

The Calvin Cycle, however, is part of photosynthesis in plants, where it fixes carbon dioxide into glucose. It is not involved in cellular respiration.

Conclusion: The Calvin Cycle is not a component of cellular respiration.

 Quick Tip

Distinguishing between cellular respiration and photosynthesis is fundamental in understanding energy flow in biological systems.

14. Approximately how long is the DNA molecule in a single human cell if stretched out?

- (1) 2 meters
- (2) 2 centimeters
- (3) 2 kilometers
- (4) 2 micrometers

Correct Answer: (1) 2 meters

Solution: A single human cell contains approximately 2 meters of DNA when fully stretched out. This extensive length is compacted and organized within the cell nucleus through a complex structure involving histones and higher-order chromatin folding. Despite the long length, DNA is efficiently packaged to fit inside the microscopic nucleus of the cell.

DNA Packaging:

2 m → Wrapped into histones → Forming nucleosomes → Folding chromatin fibers → Chromosomes

Conclusion: The DNA in a single human cell, if stretched out, measures approximately 2 meters in length.

 Quick Tip

Despite its length, DNA's efficient packaging allows it to fit within the confined space of the cell nucleus, enabling the storage of vast genetic information.

15. Which disease is characterized by symptoms such as dehydration, excessive loss of water in urine, and absence of glucose in the urine?

- (1) Diabetes Mellitus
- (2) Diabetes Insipidus

- (3) Hyperthyroidism
(4) Addison's Disease

Correct Answer: (2) Diabetes Insipidus

Solution: Diabetes Insipidus (DI) is a condition characterized by intense thirst and the excretion of large amounts of severely diluted urine, which contains little to no glucose. Unlike Diabetes Mellitus, which involves high blood glucose levels and the presence of glucose in the urine, DI is related to the body's inability to regulate water balance due to issues with antidiuretic hormone (ADH) or the kidneys' response to ADH. This leads to excessive water loss, dehydration, and electrolyte imbalances.

Types of Diabetes Insipidus:

- **Central DI:** Caused by insufficient production of ADH from the pituitary gland.
- **Nephrogenic DI:** Results from the kidneys' insensitivity to ADH.

Conclusion: Diabetes Insipidus is identified by dehydration, excessive water loss in urine, and the absence of glucose in the urine.

💡 Quick Tip

Distinguishing between Diabetes Mellitus and Diabetes Insipidus is essential, as they involve different hormones and treatment approaches despite similar names.

CHEMISTRY

1. In an acidic buffer, if the ratio of base to acid concentration is increased by 100 times, then find the increase in pH of the buffer solution.

- (1) 1
(2) 2
(3) 0
(4) 4

Correct Answer: (2) 2

Solution: Using the Henderson-Hasselbalch equation:

$$\text{pH} = \text{pK}_a + \log \left(\frac{[\text{A}^-]}{[\text{HA}]}\right)$$

If the ratio $\frac{[\text{A}^-]}{[\text{HA}]}$ increases by 100 times, then:

$$\Delta \text{pH} = \log(100) = 2$$

Therefore, the pH increases by 2 units.

Conclusion: Increasing the base to acid concentration ratio by 100 times results in a pH increase of 2 units in the buffer solution.

 Quick Tip

The Henderson-Hasselbalch equation illustrates how the pH of a buffer solution depends on the ratio of conjugate base to acid. A tenfold increase in this ratio results in a pH increase of 1 unit.

2. What is an example of a thermoplastic?

- (1) PHBV
- (2) Polystyrene
- (3) Nylon 6,6
- (4) Bakelite

Correct Answer: (2) Polystyrene

Solution: Polystyrene is a common example of a thermoplastic polymer. Thermoplastics are materials that become pliable or moldable above a specific temperature and solidify upon cooling. Polystyrene can be melted and reformed multiple times, making it suitable for various applications such as packaging, insulation, and disposable cutlery.

In contrast, Bakelite is a thermosetting polymer, which undergoes a chemical change when cured and cannot be remelted or reshaped after the initial formation.

Conclusion: Polystyrene exemplifies thermoplastics due to its ability to be repeatedly melted and molded without undergoing irreversible chemical changes.

 Quick Tip

Thermoplastics like polystyrene are widely used in manufacturing because they can be easily recycled and reshaped, unlike thermosetting plastics which are permanent after setting.